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WT-1318

OPERATION REDWING—PROJECT 2.64

FALLOUT LOCATION and DELINEATION by AERIAL SURVEYS (U)

DELETED VERSION ONLY

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ABSTRACT

The objectives were to: (1) survey the gamma radiation from fallout-contaminated ocean areas by means of aerial detectors and (2) from the aerial detectors make air-absorption measurements so that the data might be related to the dose rates at 3 feet above the sea.

Radiation detectors were mounted in P2V-5 aircraft that surveyed the ocean areas of expected fallout after Shots Cherokee, Zuni, Flathead, Navajo, Mohawk, and Tewa. A control center coordinated all air and surface radiation-survey activities to insure complete coverage of the fallout area. The contamination densities in the delineated areas were related to the percentage of the total yield that produced fission products. Gamma-isodose plots were prepared from data obtained during Shots Zuni, Flathead, Navajo, and Tewa. No fallout could be located following Shot Cherokee and only on atoll islands after Shot Mohawk.

Zuni, a land-surface shot, contaminated 13,400 naut mi^2 of ocean with 48 percent of its fission-product yield.

Navajo, a water-surface shot, contaminated 10,500 naut mi^2 with 50 percent of the fission-product yield. After Flathead, another water-surface shot, the outer boundary could not be determined because of contamination of project aircraft on D + 1 day by airborne radioactive material that resulted in a high background. However, extrapolated values indicate 29 percent of its fission-product yield was present as fallout in the local area. The fallout from the water-surface shots was concentrated primarily in the more remote areas, and a relatively small amount fell close to ground zero.

Tewa, a reef shot, contaminated 43,500 naut mi^2 of ocean with 28 percent of the fission-product yield.

Helicopters and P2V-5 aircraft were used to gather data for air-absorption measurements.

The aerial-survey technique may be used directly for radiological surveys over land. Over the sea, the depth of mixing of the fallout in the water volume must be determined before the survey results may be converted to equivalent land-fallout contours and contamination-density distributions. Data on depth of mixing was obtained from samples of sea water collected by the U.S. Naval Radiological Defense Laboratory and the Scripps Institute of Oceanography. Repeated aerial surveys provided information on the stability of the contaminated volume.

TABLE 3.1 ALTITUDE RADIATION DATA OVER LAND (ENIWETOK ATOLL)

Altitude	mr/hr*	mr/hr†	mr/hr‡	mr/hr§	mr/hr¶	mr/hr**
ft						
1,000				1.0, 1.1††		
800			130	1.5		
600			180	1.8		
500	0.7				18	5.7
400				2.8		
300	1.0	1.2			30	8.5
200	1.9	1.9	500	4.1	42	12.5
100			950		70, 55††	18.0
75			1,200			
50	2.5	2.3	1,700	11.0		

* Mohawk + 2, over Tilda, scintameter TH-3, S/N 25 in helicopter.
† Mohawk + 2, over Tilda, scintameter, TH-3, S/N 2 in helicopter.
‡ Mohawk + 2, over Sally, scintameter, TH-7, S/N 3 in helicopter.
§ Seminole D-day, over Janet, scintameter TH-3 in helicopter.
¶ Mohawk + 1, over Janet, scintameter, TH-3, in P2V-5.
** Mohawk + 1, over Janet, Top Hat radiation detector in P2V-5.
†† Values from repeat runs.

gamma-emission energy that is considerably softer than the radium used in instrument calibration, the sodium iodide detector should read high on an actual survey.

The data in Table 3.1 were normalized to the theoretical curve, and are shown in Figures 3.2 and 3.3.

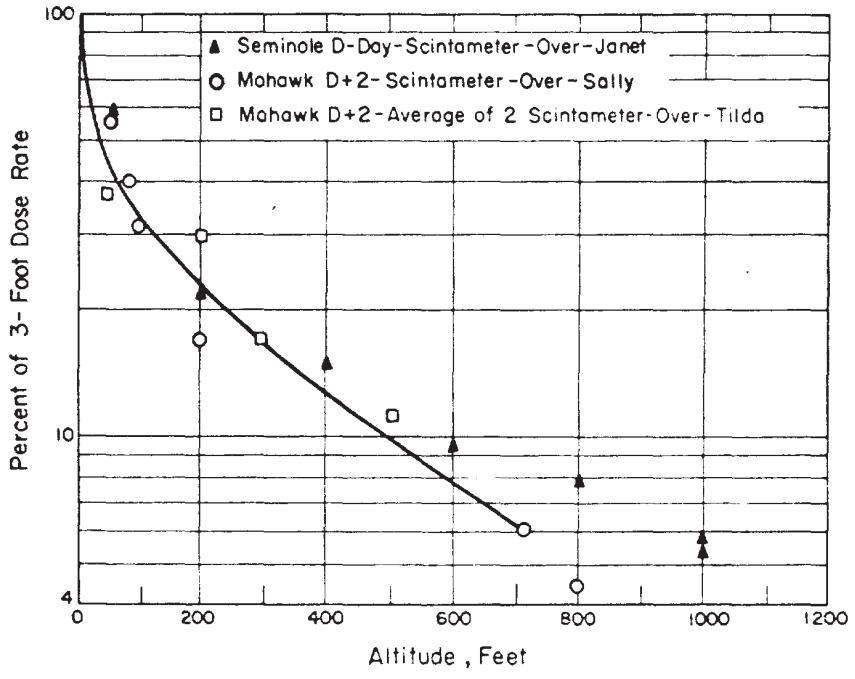

Figure 3.2 Radiation attenuation over land (Helicopter).

Table 3.2 summarized the data obtained over water, and these are plotted in Figure 3.4.

Additional data of this type have been derived from measurements made in previous operations. This information is presented in Appendix C. The curves in Figures C.1 and C.2 show a similar correspondence to the theoretical curves.

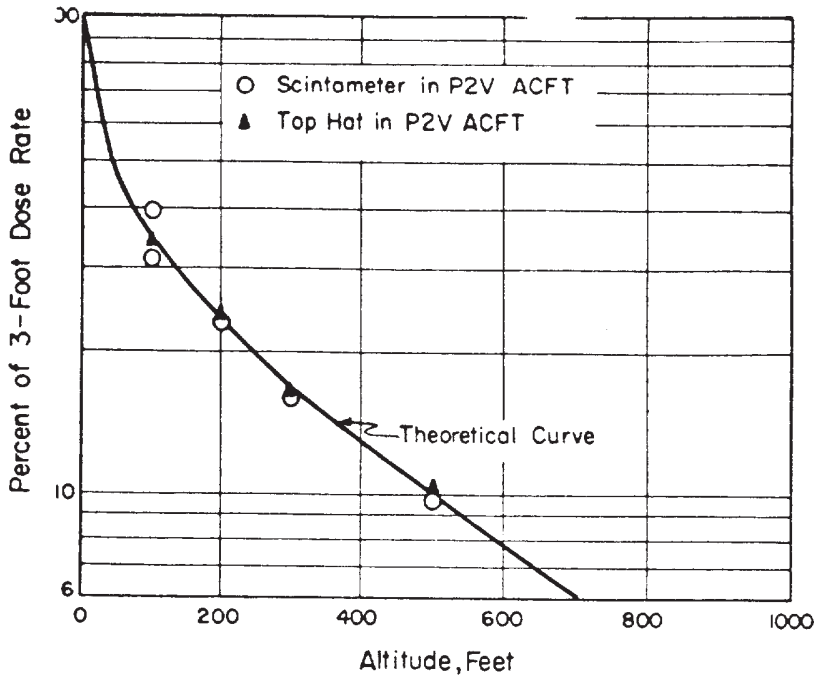

Figure 3.3 Radiation attenuation over land (P2V-5 aircraft).

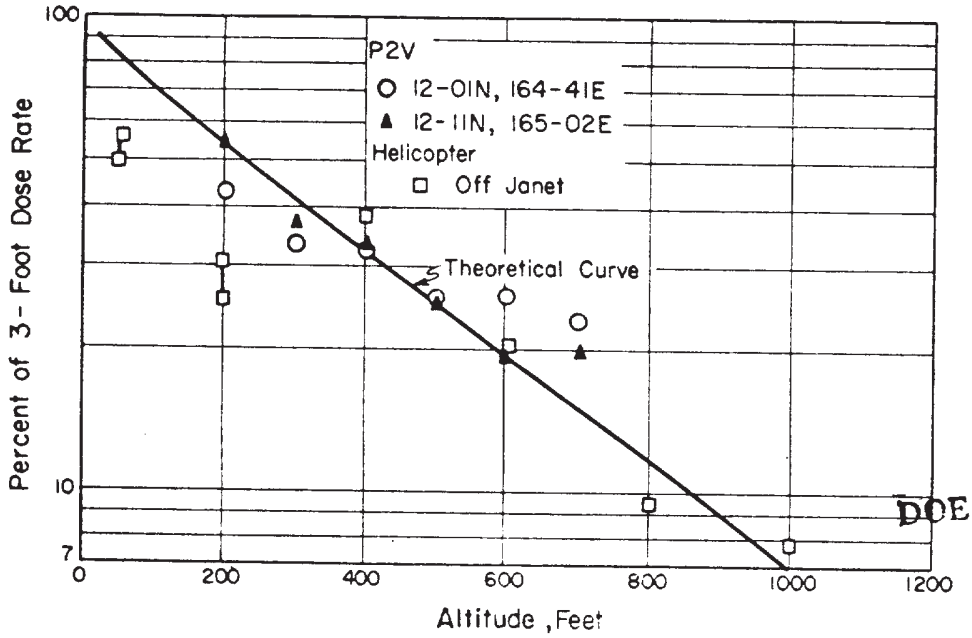

Figure 3.4 Radiation attenuation over water.

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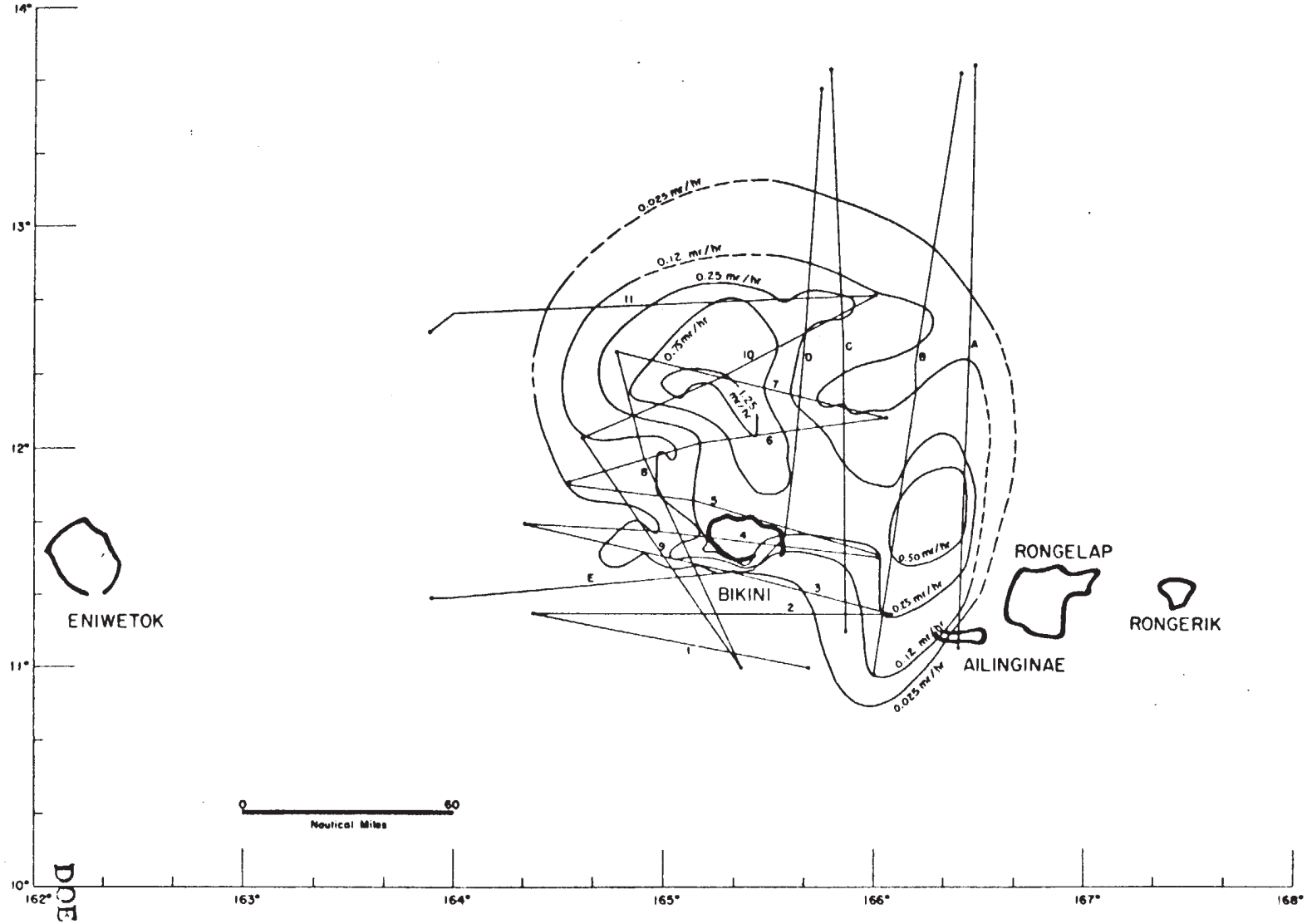

Figure 3.7 Flight pattern, Shot Zuni, D+1 day. All data readings referred to H+24 hours and 3 feet above surface. Numbers show legs flown by Aircraft 1, letters show legs flown by Aircraft 2.

The D + 1 fli ; located the EOB and delineated the co. ninated areas (Figure 3.7). A contaminated patch was suspected to be northeast of Bikini, based on the control center plots. During the data reduction, a navigational reporting error was discovered which changed the relatively isolated patch from the northeast to a position almost due east of Bikini.

TABLE 3.2 ALTITUDE RADIATION DATA OVER WATER

Altitude	mr/hr*	mr/hr†	mr/hr‡
ft			
1,000			0.41
800			0.52
700	0.12	0.225	
600	0.135	0.225	1.1
500	0.135	0.29	
400	0.175	0.38	2.1
300	0.175	0.42	
200	0.225	0.62	1.4, 1.7§
50			2.6, 3.0§

* Tewa + 3, 12-01 N, 164-41 E, Top Hat detector in P2V-5.

† Tewa + 3, 12-11 N, 165-02 E, Top Hat detector in P2V-5.

‡ Seminole D-day, off Janet, scintameter, TH-3, in helicopter.

§ Values from repeat runs.

The D + 2 flights (Figure 3.8) investigated the northeast sector without discovering contamination. The eastern contamination was not suspected until the data-reduction period, so no further examination was scheduled in that sector.

The D + 3 flights (Figure 3.9) reconfirmed the hot area. No further flights were scheduled,

TABLE 3.3 SUMMARY OF FALLOUT DISTRIBUTION, ZUNI

Isodose	Area	Difference Area	Average	Contamination
mr/hr	mi^2	mi^2	mr/hr	mc
D+1				
1.25	165	165	1.25	83
0.25	4,677	4,512	0.59	1,065
0.125	8,433	3,756	0.18	270
0.025	13,683	5,250	0.06	126
				1,544 mc at H+24 hours
D+3				
0.75	757	757	1.25	379
0.25	6,775	6,018	0.50	1,204

as low intensities were encountered on this day.

The fallout distribution is summarized in Table 3.3.

3.3.3 Shot Flathead. The D-day flight discovered relatively high dose rate just west of Bikini (Figure 3.10). The position immediately adjacent to the reef indicated that this could be lagoon water passing over the reef, rather than fallout. This area was not completely mixed,

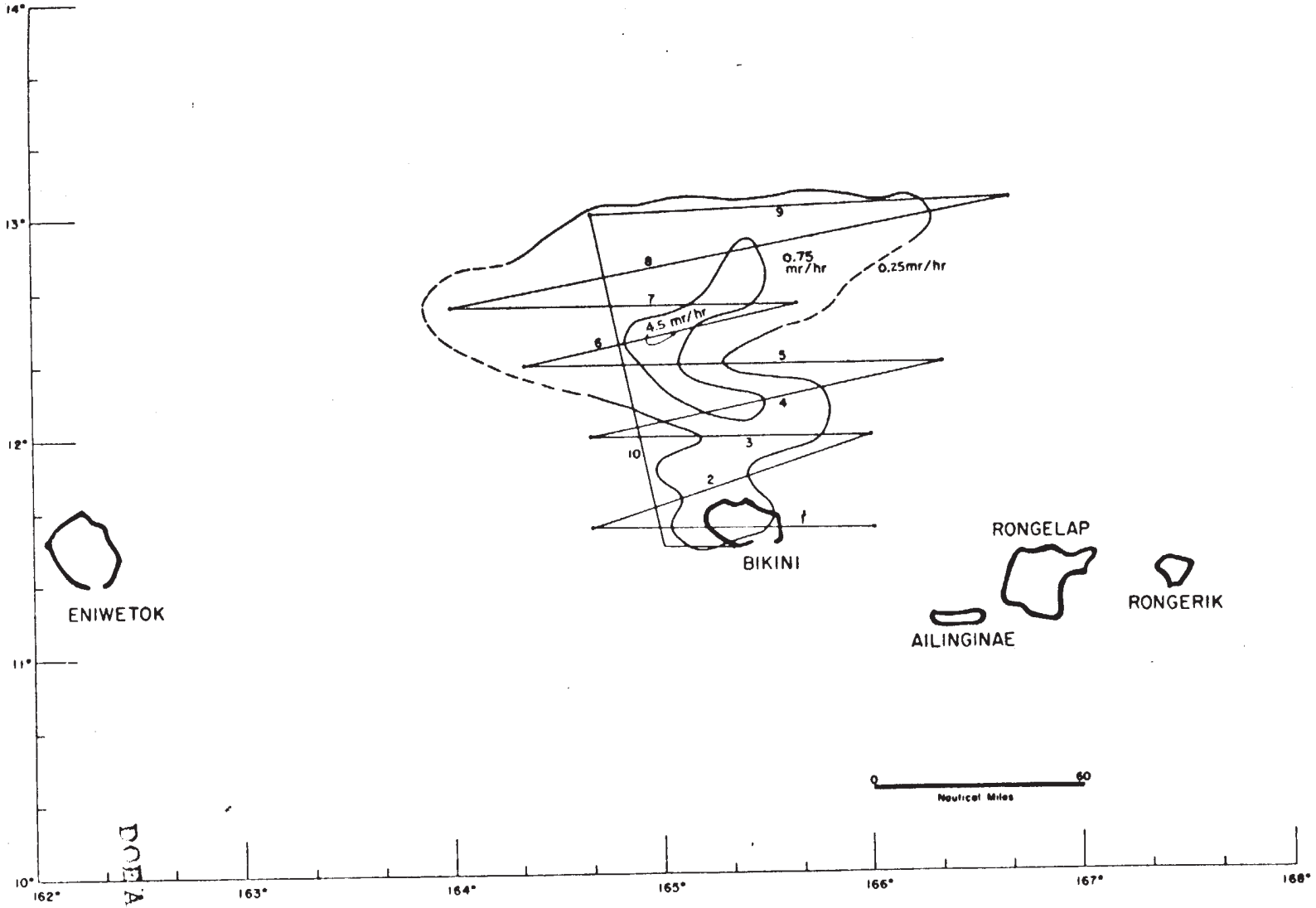

Figure 3.9 Flight pattern, Shot Zuni, D+3 days. Numbers indicate flight legs. All data readings referred to H+24 hours and 3 feet above surface.

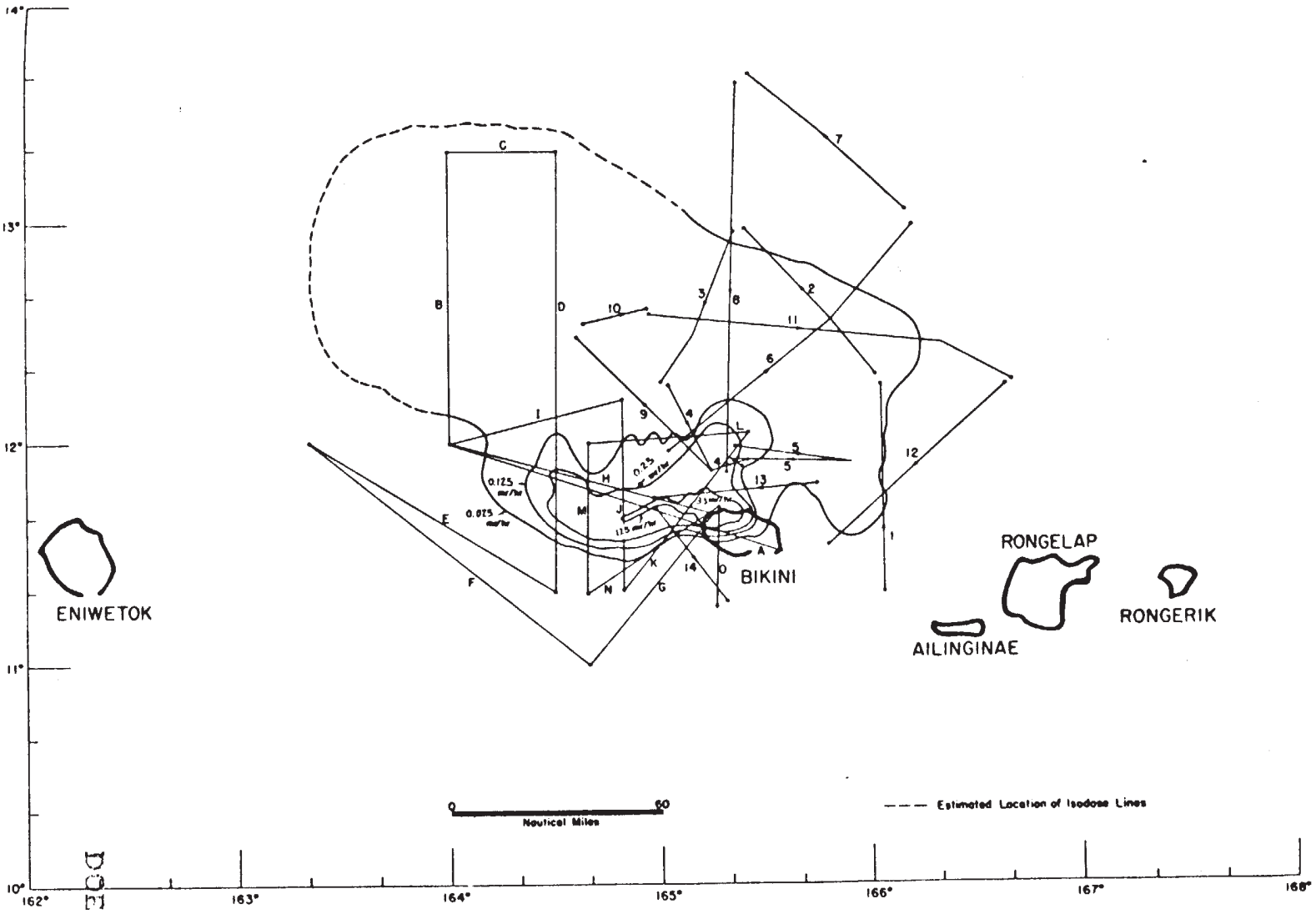

Figure 3.18 Flight pattern, Shot Navajo; D + 1 day. All data readings refer to H + 24 hours and 3 feet above surface. Numbers show legs flown by Aircraft 1, letters show legs flown by Aircraft 2.

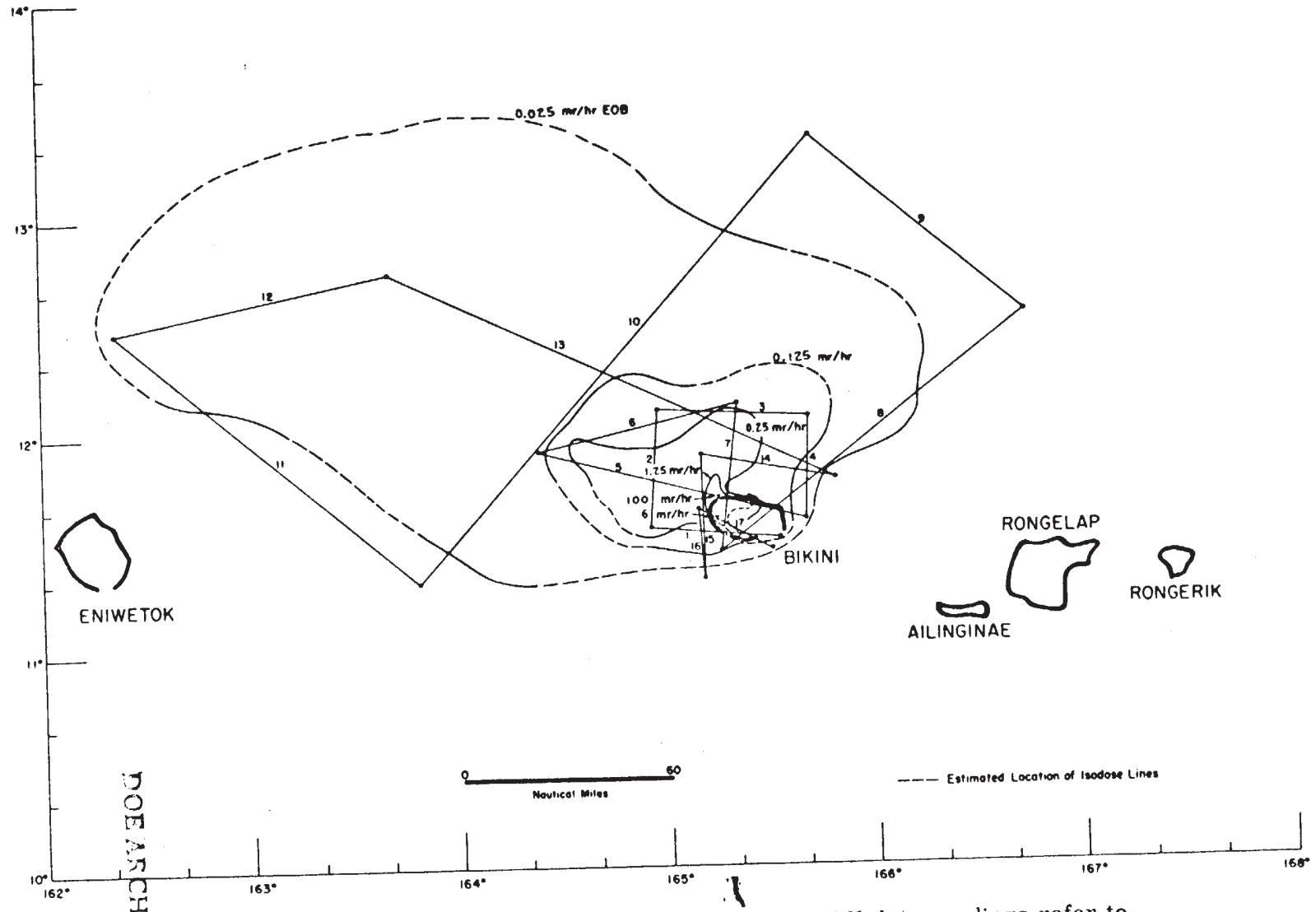

Figure 3.19 Flight pattern, Shot Navajo, D + 2 days. All data readings refer to H + 24 hours and 3 feet above surface. Numbers show legs flown by aircraft.

shot, Flathead, ı. .h of the fallout remains airborne. Thus, .allout and mixing in the sea could be expected to persist well into D + 1.

3.3.6 Shot Tewa. A D − 1 survey (Figure 3.20) defined the background status to the west of the atoll, prior to the shot. The D-day flight (Figure 3.21) located the upwind boundary. The

TABLE 3.5 SUMMARY OF FALLOUT DISTRIBUTION, NAVAJO

Isodose	Area	Difference Area	Average	Contamination
mr/hr	mi²	mi²	mr/hr	mc
D + 1				
1.25	158	158	1.35	85
0.25	958	800	0.75	240
0.125	1,788	830	0.18	60
0.025	10,490*	8,702	0.06	209
				594 mc at H + 24 hours
D + 2				
1.25	90	90	1.35	49
0.25	1,267	1,177	0.75	353
0.125	3,263	1,996	0.18	144
0.025	20,930*	17,667	0.06	424
				970 mc at H + 24 hours

* Based on estimate of isodose position.

D + 1 survey (Figure 3.22) discovered a contaminated area extending over 200 miles west of Bikini. The outside boundary could not be closed on this survey, because of the far-out sector contained active fallout from Shot Huron. The D + 2 survey (Figure 3.23) extended the estimated position of the EOB. The isodose was still not completely closed. The aircraft was not allowed to lose radio contact, so the survey covered only the area out to 275 miles from Bikini.

The 0.25 mr/hr isodose extended into the far northwest sector on D + 1. By D + 2, the position had shrunk to approximately a third of the enclosed area. The predicted pattern shows that this far-out material could not be expected to arrive before H + 19 hours. Thus, it is probable that the readings in the area on D + 1 were due to material that was not completely mixed. By D + 2, some 30 hours had elapsed, and mixing was probably complete.

The D + 3 and D + 4 surveys, Figures 3.24 and 3.25, delineated the hot area, permitting an examination of the shape and position of these inner areas from D + 1 through D + 4. Table 3.6 summarizes the fallout areas throughout the shot participation.

Figure 3.19 Flight pattern, [illegible]. Numbers show legs flown by [illegible] H + 24 hours and 3 feet above surface.

3.4 SAMPLES OF CONTAMINATED SEA WATER

Duplicate samples of sea water were furnished to this project by the U.S. Naval Radiological Defense Laboratory (NRDL) and by Scripps Institution of Oceanography (SIO) from their sea-sampling programs. After the close of Operation Redwing, these samples were analyzed for beta activity in the particulate and salt fractions at the HASL.

3.4.1 Gamma Radiation as a Function of Beta Activity. The analysis of each sample, the gamma intensity estimated at each sampling location, and the comparison of these results are contained in Appendix D. A straight averaging of the beta activity and the estimated gamma intensity yields a figure of 4×10^6 (dis/min)/liter per mr/hr. The wide variability of the comparison for each sample obviates definite conclusions. However, much of the data falls within ± 50 percent of the theoretical calculation of 4.43×10^6 (dis/min)/liter of beta activity per mr/hr of gamma activity 3 feet above the surface. Thus, these results may be considered indicative of validity of the assumption.

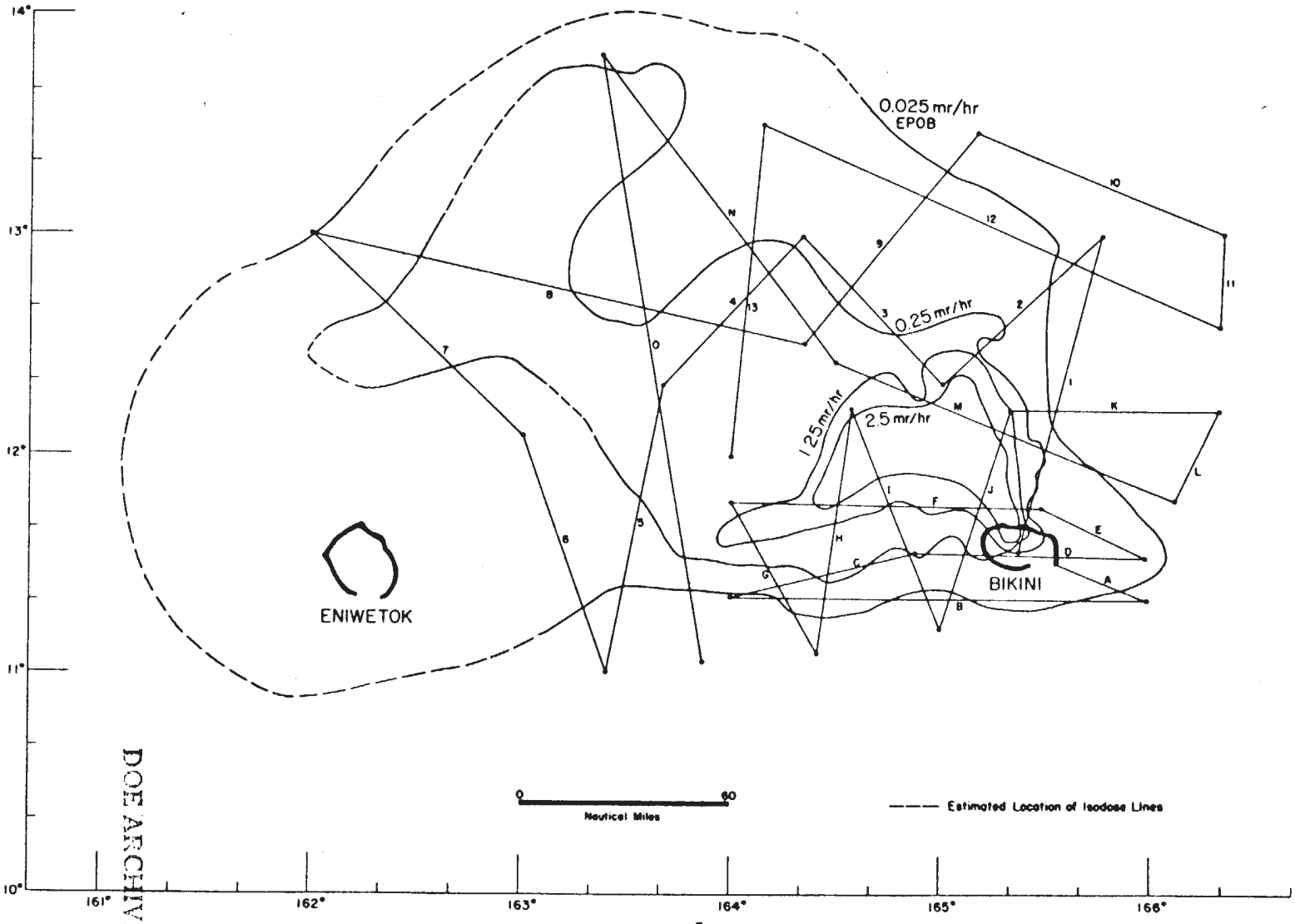

Figure 3.22 Flight pattern, Shot Tewa, D+1 day. All data readings refer to H+24 hours and 3 feet above surface. Numbers show legs flown by Aircraft 1; letters show legs flown by Aircraft 2.

Figure 3.24 Flight pattern, Shot Tewa, D + 3 days.
H + 24 hours and 3 feet above surface.

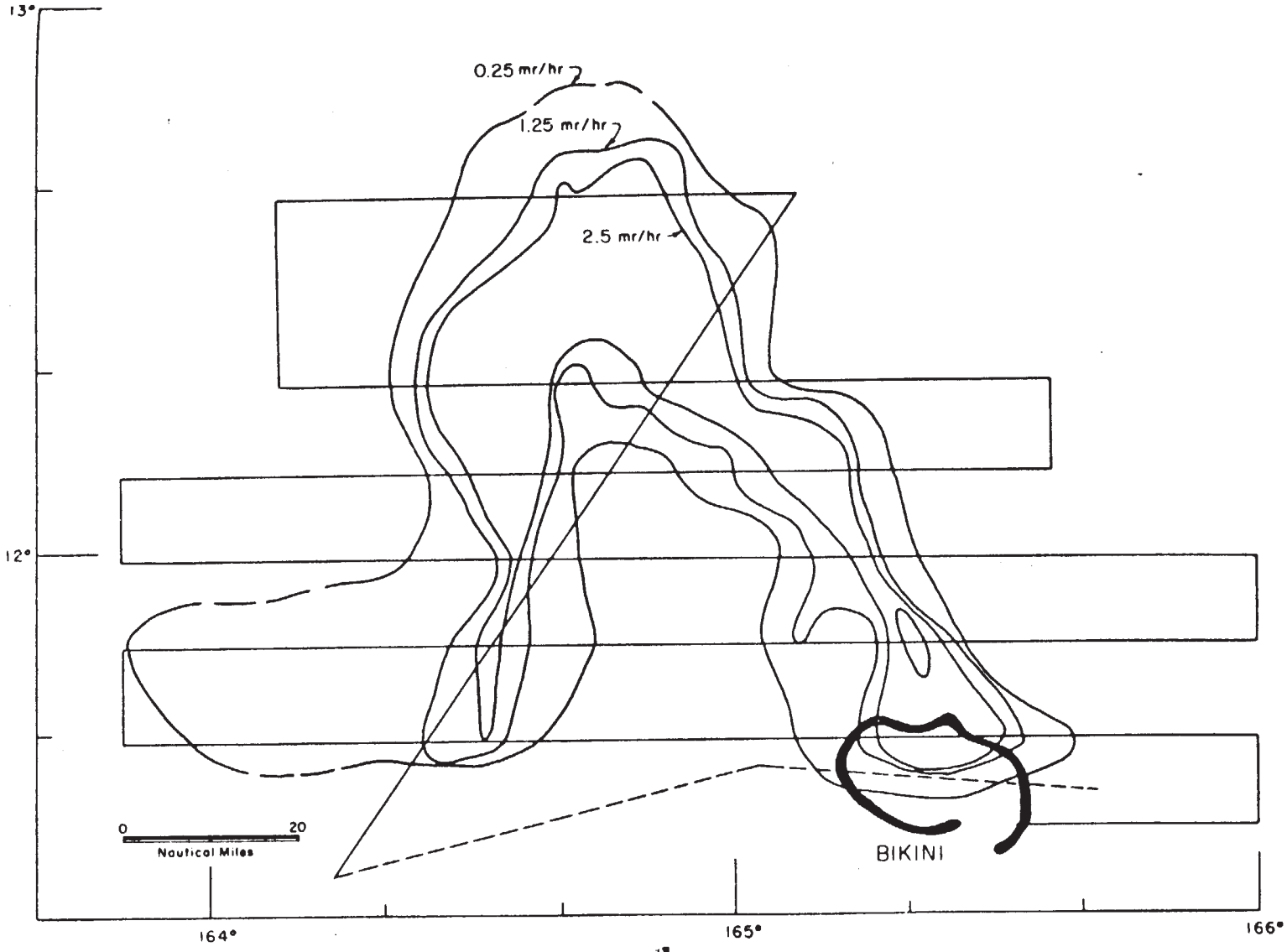

Figure 3.25 Flight pattern, Shot Tewa, D + 4 days. All readings referred to H + 24 hours and 3 feet above surface.

TABLE 3.6 SUMMARY OF FALLOUT DISTRIBUTION, TEWA

Isodose	Area	Difference Area	Average	Contamination
mr/hr	mi^2	mi^2	mr/hr	mc
D+1				
2.5	1,230	1,230	5	2,460
1.25	2,390	1,160	1.84	858
D+2				
2.5	1,150	1,150	5	2,300
1.25	2,340	1,190	1.84	880
0.25	6,750	4,410	0.75	1,323
0.025	43,505	39,095	0.125	1,955
				6,458 mc at H+24 hours
D+3				
2.5	982	982	5	1,964
1.25	2,035	1,053	1.84	779
D+4				
2.5	1,070	1,070	5	2,140
1.25	1,695	625	1.84	462
0.25	3,580	2,955	0.75	887

TABLE 3.7 SUMMARY OF DEPTH SAMPLES OF SEA WATER

Shot	Station	Sample Time	Distance*	Surface	Total
		H+hours	naut mi	10^3(dis/min)/liter	10^3(dis/min)/cm^2
Flathead	F-2	29.5	32	20	93
Flathead	F-5	49.5	39	32	205
Navajo	N-17	90	—	230	658
Tewa	T-5	41	31	266	1,514
Tewa	T-7	52	54	124	563
Tewa	T-8	59	13	51	412

* Distance from surface zero.

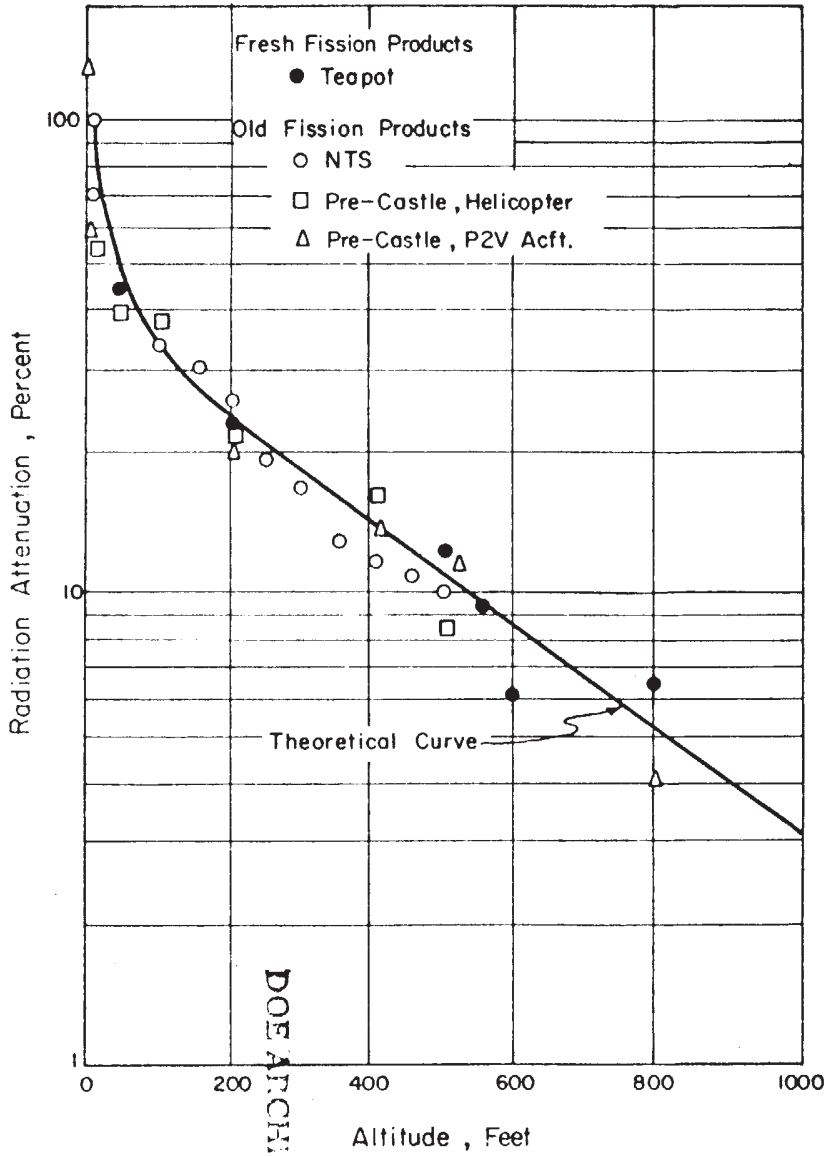

Figure C.1 Radiation attenuation over land.

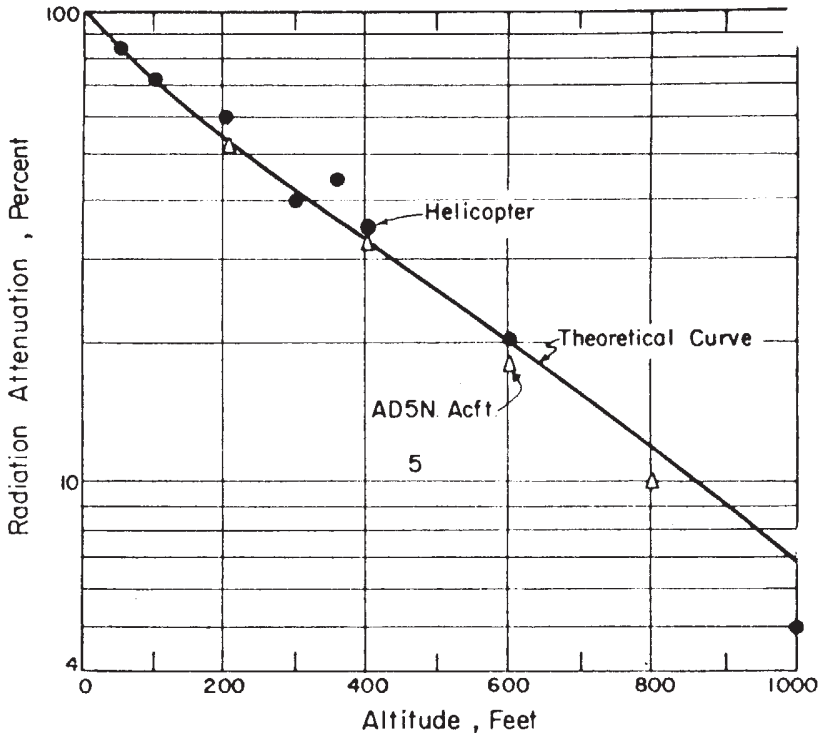

Figure C.2 Radiation attenuation over water.